AERONAUTICAL AND ASTRONAUTICAL ENGINEER

DEVELOPMENT AND VERIFICATION OF AN AERODYNAMIC MODEL FOR THE NPS FROG UAV USING THE CMARC PANEL CODE SOFTWARE SUITE

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The CMARC panel-code is evaluated for the development of an aerodynamic model of the Naval Postgraduate School FROG Unmanned Air Vehicle (UAV). CMARC is a personal computer hosted panel-code software suite for solving inviscid, incompressible flow over complex three-dimensional bodies. A panel model of the NPS FROG UAV is developed to obtain stability derivative data at the cruise flight condition. Emphasis is placed on comparing the CMARC data to aerodynamic models obtained from classical design techniques and parameter estimation. Linearized longitudinal and lateral-directional state-equation models are used to compare the dynamic response of each data set. In addition, CMARC is used to generate static-source and angle-of-attack sensor position corrections. Position corrections are provided in look-up table and curve-fit formats. The aerodynamic model obtained with CMARC demonstrated higher fidelity dynamic longitudinal response than the classical design model. Dynamic lateral-directional response is similar to that obtained from classical design techniques. Adjustment through comparison with flight-test data is still required to optimize the CMARC model. Future studies should concentrate on improving CMARC modeling of fuselage side force through the addition of wake separation lines. Additionally, the propeller disk should be modeled in an attempt to capture the effects of increased dynamic pressure over the horizontal and vertical tail surfaces.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Modeling and Simulation

KEYWORDS: Unmanned Aerial Vehicles, UAV, CMARC Panel Method, Ames Research Center, PMARC, Panel Code, Stability Derivatives, Boundary Layer Code, Aircraft Dynamic Response

QUANTITATIVE STRUCTURAL RELIABILITY ASSURANCE THROUGH FINITE ELEMENT ANALYSIS

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Risk assessment of aging aircraft components can be achieved by operational de-rating using a safety factor subjectively selected from experience and heuristics. This investigation involves synthesizing currently available, maturing computer-aided methods into a format of objective quantitative risk assessment. The methodology is applied to quantify the effect of corrosion on P-3C main landing gear lower drag struts. This kind of synthesis is appropriate wherever structural operational risk is a concern. The P-3 has undergone many modifications since the 1950s and the lower drag struts are being scrapped due to internal surface corrosion. The corrosion process is random, resulting in pits varied spatially and in severity. These corrosion attributes are merged into a one random variable probability model. The casual relation of the corrosion to structural load is analyzed by finite elements. The structural configuration model input is provided by computer-aided drafting, verified by physical measurement. The effect of corrosion on current strut population reliability, as well as the future, is computed. The conclusion is that even under severe corrosion, compressive buckling is not an issue. All the other failure modes (compressive yielding, tensile yielding, and fracture by fatigue) can be assured by one cold temperature proof test.

DoD KEY TECHNOLOGY AREA: Air Vehicles

KEYWORDS: Column Buckling, Corrosion, Finite Element Analysis, Probability, Reliability Assurance, Risk Assessment

ELECTRICAL ENGINEER

DESIGN OF A MICROELECTRONIC CONTROLLER WITH A MIL-STD-1553 BUS INTERFACE FOR THE TACTILE SITUATION AWARENESS SYSTEM

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Spatial Disorientation (SD) is a triservice aviation problem that costs the Department of Defense more than $300 million annually in destroyed aircraft and is the primary cause of pilot-related mishaps in the Navy and the Air Force. As one solution to the SD problem, the Naval Aerospace Medical Research Laboratory has developed the Tactile Situation Awareness System (TSAS). The primary objective of TSAS is to enhance pilot performance and reduce SD-related aircrew/aircraft losses by providing continuous non-visual information using the normally underutilized sensory channel of touch. Using vibrotactile stimulators, TSAS applies information taken from the aircraft's instruments to the pilot's torso. The current implementation of TSAS is a research system that is not compatible with the crowded cockpit of modern aircraft. This thesis presents a design of a microelectronic controller for TSAS compatible with tactical environments. This new system, called the Tactor Interface Microcontroller System (TIMS), incorporates the functionality of the research TSAS into a palm-sized microcontroller system and enables TSAS to communicate directly to the computerized sensory and weapons systems in combat aircraft such as the Navy F/A-18. TIMS brings the TSAS prototype out of the research stage and puts this exciting technology into the hands of the warfighter.

DoD KEY TECHNOLOGY AREAS: Electronics, Human Systems Interface

KEYWORDS: Electronics, Human Systems Interface, TSAS, Embedded System